



DOI: 10.54919/physics/55.2024.14lb6

On improving the professional training of future biology teachers

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Abstract

Relevance. Higher education is designed to transfer to the student the knowledge, skills, and abilities in a particular field, promote the formation of humanistic values, broaden the student's horizons, develop his/her ability to make creative solutions, and practice self-study. Professional training of future biology teachers shifts the focus to upbringing, developmental functions of education, the formation of a future teacher's personality, his/her holistic spiritual and moral development, high psychological stability, and readiness for the profession.

Purpose. The study aimed to develop and substantiate the professional training of future teachers when studying pedagogical, methodological, and natural disciplines in pedagogical universities to promote the development of cognitive and professional interest of graduates, the formation of deep and persisting knowledge, and activate their professional self-determination.

Methodology. We have identified the main directions for the formation of professional qualities of students in the upbringing and training process and during production practice (visits to the best schools; conducting lectures, practical and laboratory classes with the elements of profiling; the use of professional literature, elective courses, etc.).

Suggested Citation:

Gaissina K, Childibaev Z, Tatarinova G, Kunakbayev A, Tashenova G. On improving the professional training of future biology teachers. *Sci Herald Uzhhorod Univ Ser Phys.* 2024;(55):137–146. DOI: 10.54919/physics/55.2024.14lb6

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Results. Professional training of future biology teachers allows the subject of activity to reach the level that is legally required and sufficient for pedagogical activity.

Conclusions. A 21st-century teacher should possess the following qualities: reflectivity in thinking and practical activity; tolerance; affection, love, tenderness; interest in technology and digital information; global awareness.

Keywords: vocational training; biology at school; competencies; educational process; higher educational institution; curriculum, professional qualities.

Introduction

Knowledge and professional training are the main focuses of staff training for the modern educational system. New goals are being set for society. To become a developed and competitive country, we have to become a highly educated nation. There is growing evidence that, in the 21st century, a radical transformation of the model of education is required. The new model should be oriented on the future of human civilization, which is now also changing its development paradigm. Education should meet the global community's requirements and keep pace with the future, especially in teaching natural sciences. Higher pedagogical education should as much as possible satisfy the current and future school's staffing requirements. The domestic educational system should intensively introduce innovative methods, solutions, and tools, including making distance and online learning available for everyone. Obsolete or non-demanded scientific and educational disciplines should be reviewed, focusing on high-demand and promising areas. The focus and emphasis of higher pedagogical education curricula should be changed to incorporate a study of practical teaching skills and obtaining practical qualifications [1-3].

Higher education is designed to transfer to the student the knowledge, skills, and abilities in a particular field, promote the formation of humanistic values, broaden the student's horizons, develop his/her ability to make creative solutions, and practice self-study [4; 5]. Professional training of future biology teachers shifts the focus to upbringing, developmental functions of education, the formation of a future teacher's personality, his/her holistic spiritual and moral development, high psychological stability, and readiness for the profession.

Modern pedagogical science contains a sufficient accumulated experience of studying the professional training of students in higher educational institutions. Sh. Taubayeva [6], M.Zh. Jadrina [7], K.K. Kunakova [8], B.Z. Aidarov, Y.N. Kamalov, N.P. Tangkish [9], K. Isayev [10] and others [11-14] considered the essence of an expert approach and defined the concepts of "professional expertise" and "competence," the essence and structure of expertise. K. Isaev and A. Akchurin [10] studied the ratio of the concepts of expertise and competence, the structure of professional expertise. M.M. Levina [15] reviewed the formation of professional expertise in the process of additional professional-pedagogical education. V.S. Lednev [16] and I.Ya. Lerner [17] discussed the role of mastering the conceptual content in the formation of professional competence, I.A. Zimnyaya [18] – the formation of subject expertise and competencies as the basis of readiness for professional activity, Zh.B. Childibaev, R.Sh. Izbasarova and K.A. Zhumagulova [19] – competency-based approaches in professional training of future biology teachers. The works of A.S. Belkina A.V.

Karpov and O.V. Revyakina [20] were devoted to pedagogical aspects of higher pedagogical education, including the problems of professional adaptation of graduates.

Despite the achievements mentioned above, the problem of forming professional qualities in the study of natural disciplines in pedagogical universities is not solved completely [21; 22]. Namely, the tasks of forming future teachers' professional qualities when studying natural disciplines are not fully disclosed; the range of most effective tools of formation of professional qualities was not determined; the analysis of topics of the courses aimed to form professional qualities was not completed [23-27]. The study aimed to develop and substantiate the professional training of future teachers when studying pedagogical, methodological, and natural disciplines in pedagogical universities to promote the development of cognitive and professional interest of graduates, the formation of deep and persisting knowledge, and activate their professional self-determination.

Biology teacher professional training content

The content of professional training is a set of professionally significant and values orientations of the individual that are formed as a result of a regularly organized pedagogical process focused on the final result [28; 29]. However, the existing general structure of professional training content does not fully reflect the increasing qualitative changes in future biology teachers' professional training. In this regard, there is a need for the professional training of biology students which keeps up with the modern requirements focused on the competence of a specialist, involving not only a different content of education, but also a new organization of the process of obtaining knowledge, training, and improving their qualifications [30-33]. To solve the problems mentioned above, we studied and analyzed the studies of Kazakhstani and foreign scientists such as A.A. Kuznetsov [34], E.U. Medeuov [35], A.K. Kussainov [36], Zh.A. Karayev [37], M.Zh. Zhadrina [7], K.S. Kaliyev [38], L.Kh. Mazhitova [39], K.S. Musin [40], G.K. Nurgaliyeva [41], Kh.M.. Rakhimbek [42], K.E. Kuserbayev [43], A.K. Akhmetova [44] and others. They influenced the formation of theoretical concepts of education, the projects of pedagogical training that determined the formation of professional qualities in students of pedagogical universities [45; 46].

In the course of studying the reference literature, we have become certain in the correctness of choosing the concepts of "professional training," "motivational readiness for a profession," "professional self-determination," "professional abilities," "professional identity," and in their dynamic unity, interdependence, and reinforcement of each other. Professional training should

be understood as the individual level of the subject of activity, which is necessary and sufficient for implementing pedagogical activity at a normatively given level. We agree with the opinions of G.S. Batishev [45],

who offer the following structure of students' professional qualities (Table 1).

Table 1. Characteristics of professional qualities

No.	Characteristics of professional qualities	The essence of professional qualities
1.	Work efficiency by main characteristics	Performance, reliability
2.	Psychological characteristics	Cognitive, sensory, speech, mnemonic
3.	Communicative characteristics	Communication, relationships

In our study, we found out that a successful organization of professional training of future specialists at a university was influenced by such pedagogical conditions as:

1. Specialized training, which equips students with knowledge and skills about the main technological processes and technical production devices.

2. Formation of a logical structure and planning of the educational process.

3. Level differentiation of professional tasks (by the complexity of tasks, the initial preparation of students, and the profile of training).

4. Development, stocking, and use of a bank of professionally oriented tasks that combine professional content and the process of educating students.

5. The willingness of a university instructor to form students' professional qualities (not only in the courses of natural science disciplines but also in elective courses).

6. The use of training and testing programs for demonstrativeness and control over knowledge, skills, and abilities.

7. Ensuring accessibility, clarity when handing out educational material, taking into account the nature and volume of educational information to be assimilated, the level of development of students, and their life experience.

It was also identified the main forms and methods of forming students' professional qualities in the educational process, in actual practice (excursions to the best-specialized schools; conducting lectures and practical and laboratory classes with elements of profiling; independent work of students; using professional literature, elective courses, etc.). It should be noted that until now, in the theory of professional training, there is no clear and logical classification of the forms and methods of forming students' professional qualities. An appeal to the history of natural science education allows us to conclude that the basis of professional training is specialized training, which equips students with knowledge and skills on the main technological processes and technical devices of production. The consequence of this was the implementation of professional training of future biology

teachers in studying natural sciences. However, the professional potential of modern natural science is broader [47; 48].

The educational system of a pedagogical university is determined by the vision of the graduate's model as a product of the participants' joint creative activity in the pedagogical process, characterized by the ideas about the most important personal qualities that one must possess. The revealed features of the educational system make it possible to start modeling the process of forming students' professional training. As a result, we concluded that the pedagogical model of students' professional training should be understood as a purposeful process manifested in the didactic and educational subsystems' unity connected by the management system. The structural components of the educational system of pedagogical education are the tasks, objectives, principles, content of work, methods, forms, and means of achieving results, expressed in the model of a graduate of an educational institution with formed professional qualities. The Concept of 12-year secondary general education in the Republic of Kazakhstan indicates that the teacher must have a high level of formation of several competencies [49]:

1. Special competence – the ability to engage in professional activities at a high level and design own further professional development.

2. Social competence – the ability to engage in joint (collective, group) professional activities; to cooperate.

3. Educational competence – interest in obtaining professional knowledge, abilities, and skills; goal-setting in educational activities; the ability to apply the fundamentals of educational and social psychology.

Based on the previously mentioned information, a 21st-century teacher should have qualities such as:

- Reflective thinking and practice;
- Tolerance;
- Affection, love, tenderness;
- Interest in technology and digital information;
- Global awareness (Table 2).

Table 2. Criteria and indicators of professional readiness of future biology teachers

Components	Criteria	Indicators
Motivation and goal-oriented	Show interest in the study of pedagogical, psychological, methodological, natural disciplines in natural phenomena and their meaning	Develop interest in pedagogical, psychological, methodological, natural sciences through previously acquired knowledge and understand their nature
Content-related	Understanding educational processes and identifying causal relationships between them	Form a holistic picture of the learning process, and also know how to draw conclusions and inferences
Operations and activity-related	Defining the principles, laws, and patterns of learning processes, an independent attempt to solve various problematic situations	1. Use the knowledge gained in planning and carrying out practical activities (teaching practice).

		2. Draw conclusions and conclusions based on the results of experimental work. 3. Explain the results of observations and practical work via speech, graphs, symbols, images.
Reflective-evaluative	Self-assessment of activities and a vision of himself or herself in the educational and pedagogical collective.	1. Understand the very meaning of the laws and patterns of learning processes for practical use 2. Assess situations and determine the technical, energy, social capabilities of the school.

The content of educational curricula for professional training, depending on the level of qualifications, provides for:

1. When training workforce for mass professions, during the study of integrated courses in general curricula subjects that are profiling for the successful development of general professional and special disciplines, the passage of industrial training and professional practice to acquire and consolidate professional skills.

2. During the professional training of students of pedagogical universities, the following is studied:

- general humanitarian, general professional, specialized disciplines;

- implementation of laboratory and practical classes in specialized and special disciplines;

- passing industrial training and professional practice to acquire and consolidate professional skills;

3. During the preparation of highly qualified specialists, students' study:

- integrated curriculums of professional training with curriculums of 1-2 courses, which include:

- a) general humanitarian disciplines for the development of the general qualities of students, for example, History of Kazakhstan, Philosophy, Political Science, Sociology for all types of specialties;

- b) general professional disciplines taught in accordance with the object of professional activity, for example, Biochemistry, Molecular biology, Microbiology, Parasitology, Zoology, Organic Chemistry, etc.;

- c) special disciplines that form the core of professional competence regarding the level of qualifications, for example, Methods of Teaching Biology, Modern Technologies of Teaching Biology for biology teachers;

- d) the implementation of laboratory and practical classes in specialized and special courses with the passage of industrial training and professional practice.

The content of courses in specialties should:

- reflect modern advances in biology, pedagogy, technology, the methodology of teaching biology;

- take into account the norms of the organization of the educational process on credit-based technology of education;

- include the necessary competencies of specialists of the corresponding qualification level;

- provide for the possibility of using modular learning technology

- The educational curriculum determines the content of the disciplines (courses) included in each specialty's curricula.

The content of general education curricula is determined by a set of general education disciplines (GED in curricula developed based on general secondary education), the volume of which is no more than 30-35%

of the total volume of the educational curriculum, including elective disciplines. The content of educational curricula in general professional and special disciplines, industrial training, and professional practice, which reflect the theoretical and practical foundations of professional activity, make up 65-70% of the total educational curriculum. The curricula should include cycles of disciplines and types of educational work that promote acquisition and consolidation of professional qualities and skills [50; 51]. Along with compulsory and optional courses, the curricula include such courses as Biodiversity of Kazakhstan, Organization of a Biological Experiment at School, Biology at School and Phytodesign.

All the diverse professional knowledge and skills could be grouped into three conditional blocks. The first block includes knowledge about the profession of a biology teacher (professional knowledge) and information about the necessary psychological qualities of a person and the training system's specifics. The second block combines knowledge that influences the development of interest in the future profession as a field of practical activity. The examples include knowledge about modern achievements in biological and related sciences, the prospects for their development, facts from the history of scientific discoveries, and biographies and stages of professional development of prominent biologists and teachers [52-54]. The third block includes practical and professional skills. The use of various methods facilitates reaching the goals and objectives of professional training. The following groups of methods help to achieve the goals of professional training:

1. Methods for developing interest in pedagogy as a field of practical activity of people.

2. Methods of acquaintance with professions related to pedagogy and biology.

3. Methods of 'arming' with elementary professional skills.

Thus, the problem of professional training is still examined by psychologists, teachers, sociologists, philosophers, and lawyers, etc., and, as a result, the tasks of professional training at school and the issues of the structure of content are defined, the formation of professional training of students and the scientific grounds for an informed vocational choice by students are developed in great detail. However, in the course of the study, we found a gap in highlighting the didactic aspects of professional training, incomplete disclosure of the capacities of certain academic disciplines in fostering the personality of future teachers of Biology. Professional training content and methods could be implemented through various forms of education (Figure 1).

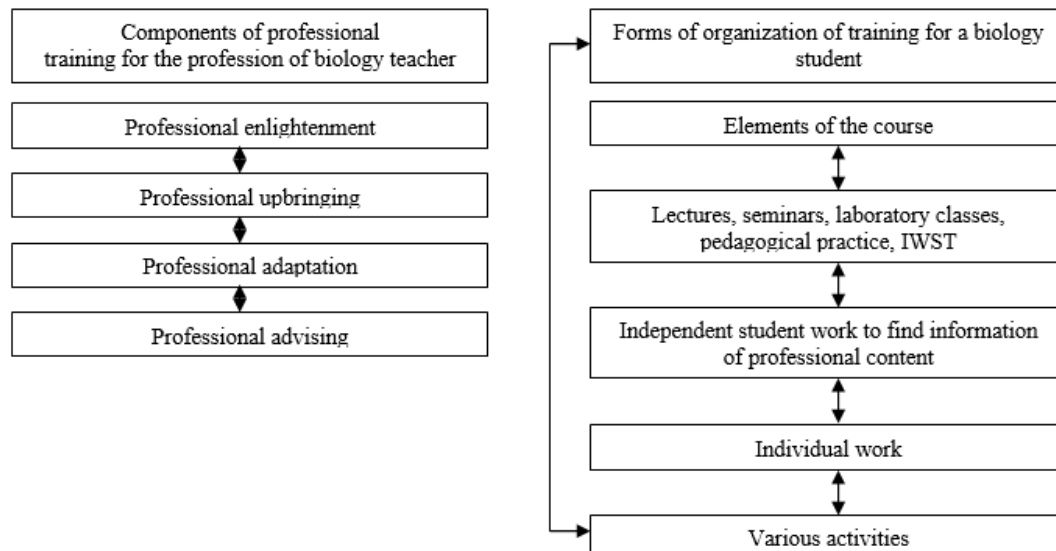


Figure 1. Implementation of the content components of professional training in various forms of education

The research program of the pedagogical experiment by the questioning method

The followings should be considered as the results of professional training:

- development of moral and professionally important qualities of the student’s personality;
- the level of formation of elementary professional skills;
- the presence of professional motivation based on formed professional interests in the future profession;
- the level of formation of knowledge about professions in the field of pedagogy and biology;
- the presence of strong psychological, pedagogical, and biological expertise and skills.

A training experiment was conducted at the Abay Kazakh National Pedagogical University in Almaty to test the effectiveness of methodology developed by us for future biology teachers’ professional training. The monitoring of student personality development that we created was tested in various types of instruction. The research program of the pedagogical experiment included the methods of questioning, testing, conversation, and observation. According to the selected indicators, students’ professional readiness could be identified in a survey (Table 3).

Table 3. Questionnaire for students

Questions of the questionnaire	
1. How do you understand the words “professional teacher”?	
2. How actively do you participate in the teaching activities of the school?	
a) very actively;	
b) not enough;	
c) I do not know.	
3. How do you understand the phrase “learning activity”?	
4. Do you think you have made the right vocational choice?	
a) yes;	
b) no;	
c) I do not know.	
5. What qualities should a biology teacher have?	
6. To what extent do you feel comfortable at school?	
a) comfortable;	
b) not comfortable;	
c) I do not know.	

The survey results made it possible to form an opinion about students' ideals, knowledge, reasoning, and value orientations (Table 4).

Table 4. Analysis of biology students' questionnaires

Degree of participation in educational and pedagogical activities	Number of groups	Very actively	%	Not enough	%	Did not answer	%
I – regularly	–	–	61%	13	39%	–	–
II – periodically	47	24	51%	21	44%	2	5%
III – do not participate	15	–	–	9	60%	6	40%
Total:	96	45	47%	43	45%	8	8%

The information above indicates that students show more positive qualities in learning activities than outside of learning. Furthermore, this is reasonable since the educational activity is a means of realizing life plans for the future for a given age. The main subject of students' educational activity is the organization, integration, systematization of individual experience by expanding and adding, and introducing new information they receive in

the learning process. We incorporated the analyzed materials into one general table for comparing the students of the experimental and control groups according to the levels of professional readiness by taking into account the motivational, cognitive, and behavioral components of the criteria (Table 5).

Table 5. Levels of professional readiness of students in the experimental and control groups

Groups	Criteria and levels of professional preparedness of students according to the results of the ascertaining experiment											
	Motivational and goal-oriented			Content-related			Operations and activity-related			Reflective-evaluative		
	B	C	H	B	C	H	B	C	H	B	C	H
Experimental	21.1	72.3	15.3	34.6	44.5	20.9	17.8	46.1	38.6	24.5	54.3	24.8
Control	7.7	29.7	62.6	32.3	42.8	24.9	15.3	42.8	45.4	17.4	40.2	44.4

The Table 5 shows that students' professional preparedness for all criteria of the highest and average levels is higher in the experimental group than in the control group. This is due to the use of training-oriented programs in the experimental group with respect to the updated content. Applied courses were offered to students. An educational system was not created in the control group: therefore, the levels of formation of professional qualities at the high and average levels were lower, and at the low levels were higher. These data allow us to conclude that the level of professional training of future biology teachers is insufficient. The information above indicates that the trainees' insufficient understanding of organizational abilities is reflected in their manifestation in activities of various types. This is a confirmation of our research on the need to give students knowledge about organizational qualities and create conditions for their manifestation in the learning process, both in educational and extracurricular activities.

The analysis of the questionnaire results showed that the majority of first-year students have low or medium levels of knowledge formation about the teacher's profession and its inherent qualities (93.0%) and, at the same time, feel the need for this kind of knowledge. Based on the data obtained, it is obvious that the issues of professional training and personal development of first-year students in the pedagogical specialty (educational area – biology) are not given due attention. To identify the formation level of students' professional preparedness and professional motivation, we asked questions: "Have you made the right vocational choice? What qualities should you possess?" An analysis of the answers shows that 45.8%

of the surveyed students have already chosen their future profession and believe that they have these professional qualities; 36.3% have not yet decided, although they stressed that there are professions that they prefer. Moreover, while 17.9% of students have already made their choice, they find it difficult to answer the question, "What qualities should they have?"

Most of the students (67.2%) consider the interest in future professional activity to be the main motive for the choice, and 41.7% of the students of the pedagogical university base their choice on material reasons, and 39.8% believe that the chosen specialty should correspond to their individual psychological qualities, while 38.8% note the importance of the manifestation of creativity. The obtained data indicate that students, as a rule, rely on the presence of interest in a certain field of activity and correctly consider the need to correlate personal qualities with the required professional qualities. However, it should be noted that the material motive prevails over the social one. Thus, as a result of the analysis of the answers of teachers and students, we can draw the following conclusions:

- most students believe that learning pedagogical disciplines does not help them in the development of professional qualities,

- first-year students have low or medium levels of knowledge about professional qualities in natural science and ecology and can lack the formation of the sphere of professional motivation,

- students experience a need to acquire deeper professional knowledge.

Simultaneously, a significant part of university instructors occasionally carries out professional training,

while important forms of the educational process organization are not sufficiently used. The results of the ascertaining experiment became a kind of starting point for a formative experiment. The point of the further pedagogical experiment was in the pedagogical guidance of the process of formation of the educational system in

professional training of biology students at a pedagogical university. The obtained data urged us to continue the work following the developed methodology for biology students' professional training (Figure 2).

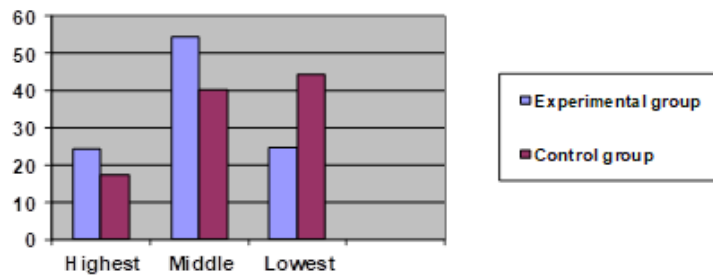


Figure 2. Dynamics of the levels of professional readiness of students

Thus, the 'ascertaining' stage results showed that the level of professional preparedness of students is not sufficiently formed; thereby, this causes the ineffectiveness of the traditional approach. In addition to the slices carried out in the control and experimental

groups, at the beginning and the end of the experimental-pedagogical work, we made slices directly in the experimental group (Table 6).

Table 6. Comparative table of the levels of professional preparedness of biology students

Professional preparedness levels	At the beginning of the background and pedagogical work
High	24.5
Medium	54.3
Low	24.8

The following conclusions can be drawn by summarizing the results of the pedagogical experiment:

- it is necessary to develop a methodology that contributes to the development of students' interests in their future profession through biology as a profile subject;
- forming elementary professional skills that improve the quality of training students through updating biological knowledge and completeness of mastering practical skills.
- the implementation of professional guidance in teaching Biology supports the process of the professional identity of students.

Conclusions

Thus, having analyzed the scientific and pedagogical literature on the research topic, we found that for successful professional training in a pedagogical university, its special organization is required, including updated forms, methods, and means in general instruction of pedagogical and biological disciplines. We have developed pedagogical conditions for the formation of professional training of biology students:

- pedagogical and methodological training that equips students with knowledge and skills about the educational process;
- formation of the logical structure of the updated content of biology as an academic subject and planning of the educational process;
- the preparedness of a university instructor to form the professional qualities of students (not only in the classes of compulsory major courses but also in elective courses);

- the use of testing programs by students for clarity and control over knowledge, skills, and abilities;
- abiding by the accessibility, clarity in the presentation of educational material, considering the nature and volume of educational information to be assimilated, the level of development of students, and their life experience.

To implement the process of forming the professional training of future biology teachers in the practice of natural science education, we analyzed the State Standard of Higher Education and standard curricula; also, to identify the nature of the formation of professional training of biology students, we conducted a questionnaire to identify the levels of personality traits. The pedagogical experiment showed that the use of professional training methods in teaching pedagogical, methodological, and natural disciplines contributes to the emergence and development of persistent interest in the future teaching profession, the development of practical and elementary professional skills, and stimulates the process of professional self-determination. Thus, the quality of students' knowledge indicates deeper assimilation of biological knowledge in the experimental groups than in the control groups. Therefore, the goal and tasks of our scientific research have been completed.

Acknowledgements

None.

Conflict of Interest

None.

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Про вдосконалення професійної підготовки майбутніх учителів біології

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Анотація

Актуальність. Вища освіта покликана передати студенту знання, уміння та навички в певній галузі, сприяти формуванню гуманістичних цінностей, розширенню кругозору студента, розвитку його здатності до творчих рішень, до самонавчання. Професійна підготовка майбутніх учителів біології зміщує акценти на виховну, розвивальну функції освіти, формування особистості майбутнього вчителя, його цілісного духовно-морального розвитку, високої психологічної стійкості, готовності до професійної діяльності.

Мета. Мета дослідження - розробити та обґрунтувати професійну підготовку майбутніх учителів у процесі вивчення педагогічних, методичних і природничих дисциплін у педагогічних університетах, що сприятиме розвитку пізнавального та професійного інтересу випускників, формуванню глибоких і міцних знань, активізації їхнього професійного самовизначення.

Методологія. Визначено основні напрями формування професійних якостей студентів у навчально-виховному процесі та під час виробничої практики (відвідування кращих шкіл; проведення лекцій, практичних і лабораторних занять з елементами профілізації; використання фахової літератури, елективних курсів тощо).

Результати. Професійна підготовка майбутніх учителів біології дозволяє суб'єкту діяльності досягти рівня, який є законодавчо необхідним і достатнім для педагогічної діяльності.

Висновки. Учитель 21 століття повинен володіти такими якостями: рефлексивність у мисленні та практичній діяльності; толерантність; прихильність, любов, ніжність; інтерес до технологій та цифрової інформації; глобальна обізнаність.

Ключові слова: професійна підготовка, біологія в школі, компетентності, освітній процес, вищий навчальний заклад, навчальна програма, професійні якості.